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This last visit was in August, 1865, and ever since that time the action in the crater has been increasing, until the floor of this vast pit has risen nearly a hundred feet, and at times has been quite inaccessible, owing to the streams of lava flowing over the surface.

THE FOSSIL REPTILES OF NEW JERSEY.

BY PROF. E. D. COPE.

In traversing New Jersey from north west to south east, we pass over rocks and soils which have been deposited by an ocean whose coast has constantly moved toward the south east, until its position has become that now forming the boundaries of the State. Hence the material now nearest the coast is that last laid down, and as we proceed towards the north west, the beds are a sediment of successively older and older date. Not, however, till we reach the red sandstone of the line of New Brunswick, do we meet with formations which have suffered a sufficient amount of pressure and heating to convert them into stone to any great extent. The gradual recession of the ocean has been occasioned by a similarly regular elevation of the land in its rear. This elevation was however, only gradual during portions of the time; between such elevations existed long periods of rest. For instance the red sandstone mentioned before was for a very long time within the shore of the ancient ocean. During that time beds were deposited outside of an older coast land, which subsiding later, were covered by newer beds, which include the remains of those creatures that have died near the

shore and been washed into the sea, or have died in the ocean. With a continued sinking, including now the red sandstone, the newer deposits reached in time the level of its summits; and during the subsequent and long continued rise, a succession of sea beaches gradually extended the area of the land to the south east. Abundant vegetation clothed the shores, which supported insect life and large herbivorous animals, which were in turn fed upon by smaller and larger carnivorous forms. The period during which the deeply buried strata at the side of the red sandstone was deposited, is called by geologists that of the Lower Cretaceous; while that which forms the surface resting upon the last, and extending from the red sandstone over nearly half the remainder of the state of New Jersey, is the Upper Cretaceous formation. During the deposition of the former, extensive beds were being laid down in various parts of the earth, especially western Europe, which entombed similar animal and vegetable types. With the Later Cretaceous of New Jersey also, corresponding strata were deposited in the far west of North America, and Europe, including in England the well known white chalk rock. At the close of this epoch, New Jersey, most probably, had accomplished in its south eastern section a very extended and considerable elevation, and at the same time vast changes in other regions of the earth caused a great change in the temperature; so great as to destroy all animal life then existing. It is also certain that the south eastern extremity of the region underwent a second gradual descent, and was again covered with water to a coast line running north east and south west, dividing the present land between the south western bend of the Delaware and the present coast line into two nearly equal areas. Then began again the deposi-

tion of beds, and the introduction of entirely new forms of animal life more like those of modern times. The period during which this deposit, so near the present coast line, was formed, as also many corresponding deposits in other regions of the earth, is called in geology, the Tertiary. Its beginning was the "morning of the sixth day" of the Mosaic record of the Creation. This great period, after having seen many changes, culminated in the creation of man. At this point history begins, and no extended geologic changes have taken place since. We have advanced six thousand years, or probably, considerably farther into the "seventh day" or period.

The beds of green marl were laid down during the upper Cretaceous period. At a suitable depth of water along the several ancient coasts, lived immense numbers of minute marine creatures, called *Foraminifera*, which inhabited delicate, almost microscopic shells, composed of numerous cells. After their death the chamber of the cells became filled with the fine mud formed of dissolved clay, oxide of iron and other substances, which are enumerated by Prof. G. H. Cook, in his valuable Report on the Geology of New Jersey. When the beds were raised, the drying, and other agencies brought to bear, decomposed the delicate shells, and left only the hardened mud as casts of their chambers. Hence the green marl now resembles gunpowder, deriving its peculiar color from the protoxide of iron.

The valuable properties of this marl, as a manure, no doubt depend on the products of the decomposition of the vegetables and animals formerly dwelling in the ocean or on the neighboring shores. The numerous fossiliferous beds, one or more of which are usually cut across by the diggings, have supplied in part this material. Most of

the animals found in these beds were bivalves, with numerous Brachiopoda and Cephalopoda, or Cuttle-fish. Of the unsymmetrical univalves, or Gasteropoda, comparatively few specimens occur in the Cretaceous marl of New Jersey.

Of Vertebrata, or those animals provided with a back bone, or vertebral column, numerous species, large and small, dwelt on the land and in the water. Their number has been so considerable, especially in the region opened by the diggings of the New Jersey Marl Company, as to materially affect the richness of the marl in phosphate of lime. Of cartilaginous vertebrates, such as the Sharks, we have found remains of the genera *Otodus*, *Lamna* and *Carcharodon*. Some of these were not only very numerous but attained a great size, and were of ferocious habits. There were also Saw-fishes closely allied to those of the present day. Fewer remains of the bony fishes, such as the Perch and Cod, have been procured from these pits; while in other neighborhoods Sword-fish and long fanged *Sphyræna* types have occurred.

In huge reptiles the region has been especially prolific. Through the care of Superintendent Voorhees, the remains of seven of the larger species have been exposed and preserved during the excavations. Four of these belonged to the group of Crocodiles; namely:—

Thoracosaurus Neocæsariensis DeKay; carnivorous.

Thoracosaurus obscurus Leidy; “

Bottosaurus Harlani Meyer; “

Macrosaurus lævis Owen; ?

Hyposaurus Rodgersi Owen; ?

These were probably dwellers by the shore, and devourers of the large fishes and of any luckless reptiles strolling on the beach. A gigantic precursor of the still

existing Lacertilia (Lizards) was probably whale-like in habit; and though not equalling these monsters in size was still formidable, attaining a length of thirty feet. It was probably in part also carnivorous. This huge reptile was called *Mosasaurus Mitchellii* by DeKay, and its remains are more numerous than any other, except those of the large *Thoracosaurus*.

Another group of animals, the *Dinosauria*, while approaching in some respects the mammals and birds, presented more of the features of the reptiles. Many of them were the giants of the land of the Cretaceous time, as well as of its waters. Those whose remains have been found in the Company's pits, are *Laelaps aquilunguis* Cope, which was carnivorous, and *Hadrosaurus Foulkii* Leidy, an herbivorous animal.

The last was the most bulky quadruped of the period yet known; a femur, or thigh bone, discovered near Had-donfield, measures nearly four feet in length. The animal is estimated by Professor Leidy to have been twenty-five feet long. The *Laelaps* has been found represented in the Company's pits, only by remains sufficient to ensure its identification, a few small pieces from the neighborhood of Freehold, described by Professor Leidy, being assignable to an allied, or doubtfully to the same genus. As the former constitute the most complete indication of any individual of a carnivorous Dinosaurian hitherto discovered considerable interest attaches to them. The great reptile, *Megalosaurus*, is known by more numerous fragments, but they have been gathered from many different localities; *Dinodon* is known only from its teeth, and *Euscelosaurus*, of the South African beds, by a femur only.

The lightness and hollowness of the bones of the *Laelaps*

arrest the attention of one accustomed to the spongy, solid structure in the reptiles. This is especially true of the long bones of the hind limbs; those of the fore limbs have a considerably less medullary cavity. The length of the femur and tibia render it altogether probable that it was plantigrade, walking on the entire sole of the foot like the bear. They must also have been very much flexed under ordinary circumstances, since the indications derivable from two humeri, or arm bones, are, that the fore limbs were not more than one-third the length of the posterior pair. This relation, conjoined with the massive tail, points to a semi-erect position like that of the Kangaroos, while the lightness and strength of the great femur and tibia are altogether appropriate to great powers of leaping. The feet must have been elongate, whatever the form of the tarsi; the phalanges, or finger bones, were slender, nearly as much so as those of an eagle, while the great claws in which they terminated were relatively larger and more compressed than in the great birds of prey. There was no provision for the retractibility observed in the great carnivorous mammalia, but they were always equipped with sheaths and crooked points of bone. The toes may have been partially webbed, and it is not improbable that the hind legs may have occasionally been most efficient propellers of these animals along the coast margins of the Cretaceous sea.

The hind foot could not have been straightened in line with the tibia, owing to a most anomalous structure which has only been once before observed, and then in a species clearly referred to its type. The distal head of the fibula, or small bone of the leg, appears to have embraced and capped the tibia like an epiphysis, and to have given attachment to the bones of the tarsus, by a condyle directed

anteriorly. The object of this structure remains unexplained. The whole hind leg could not have been less than six feet, eight inches in length.

Fragments of the jaws indicate a face of very considerable length, showing shining saw-edged, knife-shaped teeth; but any nearer idea of the beast's expression cannot now be attained. If he were warm-blooded, as Prof. Owen supposes the Dinosauria to have been, he undoubtedly had more expression than his modern reptilian prototypes possess. He no doubt had the usual activity and vivacity which distinguishes the warm-blooded from the cold-blooded vertebrates.

We can, then, with some basis of probability imagine our monster carrying his eighteen feet of length on a leap, at least thirty feet through the air, with hind feet ready to strike his prey with fatal grasp, and his enormous weight to press it to the earth. Crocodiles and Gavials must have found their bony plates and ivory no safe defence, while the Hadrosaurus himself, if not too thick skinned, as in the Rhinoceros and its allies, furnished him with food, till some Dinosaurian jackalls dragged the refuse off to their swampy dens.

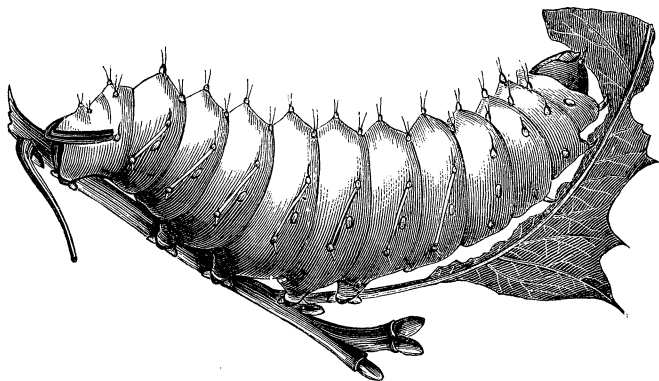
This carnivore, then, is an interesting link between those of the mammalian series, and the carnivorous birds. In the first, all four limbs are equally developed, and similarly employed as weapons of offence; in the last, the functions of the anterior pair are altogether different from those of the hind limbs, which are alone armed for the capture of food. In the Dinosaur, the hind limbs appear to have served the same purpose as in the Raptorial bird, while the fore limbs are simply miniatures of the same, and chiefly of service in carrying food to the mouth.

It will readily occur to the palæontologist, that the ex-

istence of creatures of the form of Lælaps, Iguanodon, and Hadrosaurus, would amply account for the well known foot-tracks of the Triassic Red Sandstone of the Connecticut Valley. The arguments adduced to prove that these were made by birds are equally applicable to their indicating the presence of Dinosaurians; and as the latter have been found very much more nearly approximated in time—as *Scelidosaurus* in the Jurassic formation—the latter hypothesis is altogether the more probable of the two in the estimation of the writer.

THE AMERICAN SILK WORM.

BY L. TROUVELOT.



The insect fauna of North America contains several gigantic species of moths belonging to the Lepidopterous family Bombycidae. This family has long been known to spin when in the larval, or caterpillar state, a cocoon which produces a large amount of silk, with a fibre of the most delicate texture, of great strength and of the most